GUIDELINES FOR PROTECTING JEFFERSON AND BLUE-SPOTTED SALAMANDERS AND THEIR HABITATS IN MASSACHUSETTS

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INTRODUCTION

The Natural Heritage and Endangered Species Program of the Massachusetts Division of Fisheries and Wildlife (the Division) has developed the following guidelines to assist property owners, land managers, consultants, and conservation commissioners with protecting Jefferson and blue-spotted salamanders (*Ambystoma jeffersonianum, A. laterale*) and their habitats. These salamanders are listed as Species of Special Concern by the Division in Massachusetts, and activities proposed in or near their habitats are subject to review under Massachusetts laws. The Division intends to apply these guidelines in its review of Notices of Intent, pursuant to the Massachusetts Wetlands Protection Act regulations (310 CMR 10.59). Implementing these guidelines will also help property owners and land managers avoid potential violations of the Massachusetts Endangered Species Act (MGL c. 131A) and its implementing regulations (321 CMR 10.00).

Because Jefferson and blue-spotted salamanders exist along with hybrid forms that are intermediate in size and appearance, these guidelines address both species together. Often, the observer does not definitively know whether she or he has detected pure Jefferson salamanders, pure blue-spotted salamanders, or one of the several forms of hybrids of the two. This is especially true for egg masses. Therefore, these guidelines are designed to protect both species as well as their hybrid forms.

Users of these guidelines are advised that they do not supersede any law, regulation, or official policy of this or any other agency. Rather, these guidelines are intended to complement existing regulatory review processes by providing scientifically based management recommendations. These guidelines include a summary of life history and habitat requirements of Jefferson and blue-spotted salamanders, a summary of pertinent laws and regulations, guidelines for avoiding adverse impacts to these salamanders and their habitats, and literature cited.

LIFE HISTORY AND HABITAT REQUIREMENTS OF THE JEFFERSON/BLUE-SPOTTED SALAMANDER COMPLEX

Adult Jefferson and blue-spotted salamanders spend most of their lives in forested uplands, traveling to wetlands only during the breeding season, in the late winter and early spring (Table 1). They breed in seasonal pools and swamps, usually in water less than 40 cm deep

(Hunter et al. 1999). The eggs and larvae develop over the course of the spring and early summer, metamorphosing into terrestrial juveniles by mid and late summer.

Adults migrate to breeding sites on specific nights from early March to early May (Wilson 1976), depending on environmental conditions. Jefferson and blue-spotted salamanders typically migrate on rainy nights when the air temperature is at least 1.7°C (Jackson 1990). They also will migrate under the following conditions: after daytime rain if conditions remain wet into the night; during periods without rain but with significant snow melting; and under dry spring conditions with very warm temperatures (13C) (Jackson 1990). Males tend to start migrating before females do, and therefore more males arrive at breeding sites early in the breeding season (Williams 1973, Douglas 1979, Lowcock et al. 1991, Klemens 1993).

When gathered at breeding sites, these salamanders display a courtship ritual. Males deposit spermatophores, which fertilize females' eggs internally, once females pick them up. Females lay their eggs submerged in the water. Pure blue-spotted eggs are deposited in such a way that they fall to the bottom of the water column and rest on the debris there. Hybrids and pure Jefferson females deposit their eggs by attaching them to branches, dead twigs, and other vegetation submerged in the water column. After breeding, males generally return to uplands before females (Douglas 1979).

Jefferson and blue-spotted salamanders are capable of traveling long distances away from breeding pools (Table 2). Bishop (1941) collected Jefferson salamanders up to 1,610 m away from the nearest breeding site. Radio-tagged adults have been found to travel overland up to 625 m away from a breeding site (Williams 1973). In this same study (of 86 adult salamanders in Indiana), the average straight-line distance that adults traveled from breeding sites was 252 m. The author also tracked 13 juvenile Jefferson salamanders for up to 10 days after emergence and found that they traveled 3 to 247 m away from their natal wetlands during that short time frame. The average distance traveled from natal ponds was 92 m.

Larvae develop into terrestrial juveniles and begin emerging from their natal wetlands in early July (Jackson 1990). Although the peak month of emergence is July, this activity continues into October. Emerging juveniles are about 50 mm in length (Hunter et al. 1999).

Individual adult Jefferson salamanders tend to enter and exit their breeding pools at the same point (Williams 1973, Douglas and Monroe 1981), although the different entry and exit points may be widely dispersed around the edge of a pool (Douglas and Monroe 1981). Dispersal of emergents has not been documented, so it is not known whether they emerge from natal pools at random or non-random points along the edge of the pool. Some adult Jefferson salamanders also migrate toward their breeding sites in the fall, from mid-September into December, although spermatophores and egg masses have not been observed in the fall (Williams 1973, Jackson 1990).

Table 1. General habitats required by Jefferson and blue-spotted salamanders.

Habitat type	Description	Time of year used by Jefferson & blue-spotted salamanders (in Mass.)
Breeding habitat	seasonal pools and other shallow wetlands	mid-March to late April (adults); late March to early October (eggs, larvae, and juveniles); mid-September through December (adults migrate toward breeding sites, but all do not reach the pool itself)
Non-breeding habitat	dry, upland forest	year-round (adults and juveniles)

Table 2. Distances traveled by Jefferson and blue-spotted salamanders away from breeding sites.

	Straight line distance (m)				
Life stage and location	**Minimum**	**Maximum**	**Average**	**No. of individuals (duration of study)**	**Source**
Adults					
New York	Not reported	1,610	Not reported	3 (na)	Bishop 1941[1]
Michigan	21	108	38	6	Wacasey 1961
Indiana	20	625	252	86 (2 seasons)	Williams 1973
Kentucky	not reported	not reported	250	10 (<1 season)	Douglas and Monroe 1981
Juveniles					
Indiana	3	247	92	13 (<1 season)	Williams 1973
Michigan	Not reported	>152	Not reported	Not reported	Wacasey 1961

1 – Three salamanders were collected at a location 1,610 m from the nearest breeding site. They were not actually tracked.

The life history description above is based on a general seasonal framework within which Jefferson and blue-spotted salamanders function, but it is not meant to be exact or predictable across all populations during all years. Even within the state of Massachusetts, salamander activity varies from region to region each year. Breeding population size and reproductive success are highly variable, largely due to the salamanders' dependence on fluctuating environmental conditions, such as rainfall. This dependence is apparent in the timing of breeding, migrating, and metamorphosis, all of which vary according to water and temperature levels.

Threats to Jefferson and Blue-spotted Salamanders **--** Ambystomatid salamanders are dependent on more than the protection of habitats required by a single breeding population.

Their persistence also depends on habitats that connect local populations to each other (Semlitsch and Bodie 1998). They appear to depend on a metapopulation dynamic to withstand fluctuating environmental conditions. A "metapopulation" is a population made up of several "subpopulations," also referred to as "local populations." In the Jefferson and blue-spotted salamanders' case, the subpopulations are the breeding populations, which travel to separate seasonal pools and swamps each fall. The metapopulation is the conglomerate of those breeding populations that are connected spatially (e.g. close enough together for salamanders to travel between them).

If a local population declines or is extirpated -- due to drought, for example -- salamanders from neighboring subpopulations can eventually disperse into and repopulate the depleted subpopulation. This is known as recolonization or the "rescue effect." The metapopulation dynamic is thereby, over time, a continuous "winking off" and "winking on" of breeding populations within a connected cluster of breeding populations. Ambystomatid salamanders may be absent from suitable breeding habitat one or more years, then recolonize that breeding site in subsequent years.

When habitats connecting clusters of seasonal pools and other wetlands are fragmented, local populations become isolated from each other, and the rescue effect becomes difficult or impossible to achieve (Laan and Verboom 1990, Reh and Seitz 1990). In addition, isolated populations are more vulnerable to loss of genetic diversity, and the likelihood of extinction may increase as a result (Saccheri et al. 1998). Construction that impedes movement of salamanders is a source of habitat fragmentation, and it therefore degrades the viability of that population (potentially both the metapopulation and the local population) of salamanders. Examples of impediments include roads, curbs, impermeable fencing, newly-created waterways or permanent wetlands.

Other habitat alterations threaten Ambystomatid salamanders directly. In upland habitats (overwintering, migrating, and dispersal habitats), vehicles on roads and in parking lots will likely increase the mortality of adults and juveniles. Roads across migration routes are especially detrimental when salamanders are moving over them en masse to breed or as they emerge from pools.

Outside of the breeding season, Jefferson and blue-spotted salamanders are found almost exclusively in forested areas, burrowed under leaf litter, logs, and topsoil (Williams 1973, Deegan and Berkholtz 1989, Raymond and Hardy 1991). Therefore, clear-cutting, significant forest thinning, and removal of burrowing substrate degrades or destroys salamander habitat. Ambystomatid salamanders readily use small mammal burrows (Williams 1973, Semlitsch 1981, Madison 1997), so the destruction or degradation of small mammal habitat likely adversely affect the quality of Ambystomatid habitat.

Adults feed on a variety of foods on the forest floor, including worms, snails, slugs, ants, beetles, flies (Bishop 1941). Therefore, the removal of substrates used by invertebrates (such as downed woody debris) may adversely affect the quality of feeding habitat available to Jefferson and blue-spotted salamanders.

MASSACHUSETTS LAWS THAT PROTECT JEFFERSON AND BLUE-SPOTTED SALAMANDERS AND THEIR HABITATS

Massachusetts Wetlands Protection Act – The Massachusetts Wetlands Protection Act (WPA) (MGL c. 131 s. 40) protects a variety of wetland "Resource Areas" (and, in some cases, the surrounding uplands) that can support rare, state-listed wildlife. According to the WPA's implementing regulations (310 CMR 10.00), projects that are proposed to occur in a Resource Area or associated 100-foot buffer zone, and that will alter wetland habitat of Jefferson and blue-spotted salamanders or other rare wildlife, may have "no short or long term adverse effects" on that habitat. Specific protected Resource Areas that these salamanders are likely to inhabit include: Land Under Water Body; Isolated Land Subject to Flooding; Bordering Land Subject to Flooding; Bordering Vegetated Wetlands; and Riverfront Areas (Table 4). These are defined in detail in the WPA regulations.

The Division has prepared an atlas of "Estimated Habitats of Rare Wildlife," including estimated habitat of Jefferson and blue-spotted salamanders. The atlas is available from the Division and from local conservation commissions. When a proposed project will occur within an Estimated Habitat, a copy of the project proponent's Notice of Intent to the local conservation commission must be forwarded to the Division. Within 30 days of receipt of the Notice of Intent, Division staff determine: 1) whether the proposed project would occur within actual habitat of a rare species; and, if so, 2) whether the proposed project will have any "short or long term adverse effects" on that wetland habitat. The Division submits their opinion to the applicant, the local conservation commission, and the Department of Environmental Protection. The Division's opinion is presumed correct, although it may be rebutted by clear evidence to the contrary.

The important wildlife habitat functions protected under the WPA are: feeding, breeding, migrating, overwintering, and finding shelter. Therefore, adverse impacts to habitats supporting these activities are not permitted. Replicating habitat for wetlands wildlife and moving animals to new habitat are not permitted because impacts to existing habitat still occur. According to the Department of Environmental Protection's rare species policy, "habitat replication, relocation of individual animals, or other proposed measures purported to offset adverse effects shall not be permitted because these activities cannot meet the performance standard of no adverse short or long term effect on the habitat of the local population" (DEP Rare Species Policy 90-2).

Table 3. Resource Areas (pursuant to Massachusetts Wetlands Protection Act) and associated habitat functions provided for Jefferson and blue-spotted salamanders.

Resource Area[1]	Life stage(s) associated with habitat functions Potentially provided					Comments
	feeding	**breeding**	**migrating**	**overwint-ering**	**shelter**	
Land Under Water Body	adults juveniles larvae	adults eggs	adults juveniles		adults juveniles larvae	A fish-less pond and its buffer zone can provide breeding and upland habitats.
Isolated Land Subject to Flooding (ILSF)	adults juveniles larvae	adults eggs	adults juveniles		adults juveniles larvae	ILSF can provide habitat if it contains or is near breeding habitat.
Bordering Land Subject to Flooding (BLSF)	adults juveniles larvae	adults eggs	adults juveniles	adults juveniles	adults juveniles larvae	BLSF can provide habitat if it contains or is near breeding habitat.
Bordering Vegetated Wetlands (BVW)	adults juveniles larvae	adults eggs	adults juveniles	adults juveniles	adults juveniles larvae	BVW can provide habitat if it contains or is near breeding habitat.
Riverfront Area	adults juveniles larvae	adults eggs	adults juveniles	adults juveniles	adults juveniles larvae	A Riverfront Area can provide habitat if it contains or is near breeding habitat.

1 Resource Areas (except Isolated and Bordering Lands Subject to Flooding) include a 100-foot upland buffer zone in which activities can be regulated if predicted to adversely affect the Resource Area (the wetland) itself. Riverfront Areas consist of adjacent uplands up to 200 feet from the mean high water line of a river or perennial stream. The uplands within the Riverfront Area are considered part of the Resource Area.

Assessing Impacts Under the WPA – To expedite regulatory reviews of large projects, projects with direct wetland alterations, and projects with significant buffer zone loss, applicants should follow the guidelines below.

- Applicants are strongly encouraged to conduct rare wildlife habitat evaluations prior to filing a Notice of Intent. Such evaluations are more likely to expedite the review process if conducted by a wildlife biologist with proven experience and expertise conducting surveys for the target species, in this case, Jefferson and blue-spotted salamanders. The applicant should use the information provided in the evaluation to determine whether his or her project would adversely affect rare species habitat.

- Submit the full Notice of Intent to the Division, including plans, stormwater management forms and supporting data, wetland delineation forms, any wetland assessments, and any wildlife habitat evaluations. Classifying wetland types according to Cowardin et al. (1979) will help facilitate the Division's review. Alternative analysis reports, as required under the Rivers Protection Act, must be provided.

- Clearly delineate boundaries of proposed work on a U.S.G.S. topographic map. Avoid drawing broad circles or using arrows to indicate the project locus.

- Provide plans that show the entire proposed project on one page, including streets and other landmarks. Plans drawn at a scale of 1:40 are often easiest to interpret. Delineate the limit of clearing on plans and show grading, limit of lawn, and all other project components.

- Delineate wetland Resource Areas, including Riverfront Areas, on plans. Make sure Bordering Vegetated Wetland flag numbers are clearly visible on plans. Delineate wet depressions that may be state or federal wetlands on plans.

- Provide ground-level photographs that characterize wetland types within and near the impact area(s). Label photographs and cross-reference them on 1:40 scale plans. Providing a 1:12,000 scale, color-infrared, aerial photograph (taken when leaves are off trees) with the subject property clearly marked is recommended.

- Provide land-use information for the site and neighboring lands. Include residential and commercial development, roads, agricultural land, and active or abandoned gravel pits. Demarcate these areas on the plans, if possible.

- Include detailed erosion and sedimentation control plans, particularly for sites with steep topography and for projects that will disturb large amounts of upland adjacent to wetlands.

- Submit to the Division any new or revised information presented to the Conservation Commission during the hearing process.

Massachusetts Endangered Species Act – The Massachusetts Endangered Species Act (MESA) (MGL c. 131A) prohibits the "taking" of any species of animal or plant listed as Endangered, Threatened, or Species of Special Concern. For animals, "taking" is defined as: "to harass, harm, pursue, hunt, shoot, hound, kill, trap, capture, collect, process, disrupt the nesting, breeding, feeding, or migratory activity or attempt to engage in any such conduct, or to assist in any such conduct" (321 CMR 10.02). This broad definition of “take” allows regulatory protection to be provided to individual salamanders as well as to their wetland and upland habitats.

Under certain circumstances, the Division of Fisheries and Wildlife may grant a permit allowing the “take” of state-listed species. Such “Conservation Permits” are granted only under the following circumstances (321 CMR 10.04(3)): 1) when there are no reasonable alternatives to the proposed project; 2) when the project has been modified to minimize impacts to rare species and their habitats; and 3) when the project has been designed in such a way as to provide a “net benefit” to the population(s) of affected species.

Assessing Impacts under MESA – The Division may request additional site-specific information to aid in its regulatory review of proposed projects. This will be especially true for requests for Conservation Permits that allow limited take of Jefferson and blue-spotted salamanders under MESA. Although 1 to 2 years of additional data collection is unlikely to describe all habitats used by a local population of Jefferson and/or blue spotted salamanders, it is likely to contribute information useful to the Division's review process.

In reviewing a project, the Division may request additional information on some or all of the following:

- Presence of Jefferson/blue-spotted eggs at breeding sites – Although all potential breeding sites will *not* contain eggs and larvae every year, knowing where they are surviving in a given year will help direct subsequent information-gathering efforts (see below). Eggs can be detected in the spring[1], by visually surveying breeding pools, although the success of these surveys varies greatly with water clarity, lighting, and water depth. Dip-netting in breeding pools, especially in the leaf litter at the bottoms of pools, is an effective way to find larvae in the late spring and early summer.

- Directionality (if any) of adults moving to and from their breeding sites – This is usually obtained by fencing a breeding site and placing pitfall traps (e.g. number 12 cans) at 10 m intervals along both sides of the fence line. The fence should be continuous around the entire pool, 0.5 m above the pool's high water level, to the extent topography allows. Traps should include mechanisms for:

    4. allowing the escape of small mammals (e.g. sticks that reach to the top of the trap)
    5. keeping trapped amphibians moist (e.g. sponges at the bottoms of traps)
    6. preventing flooding (e.g. drainage holes punched at the bottoms)

    Traps should be checked every morning from March 10 to May 10 to ensure that most immigrants and emigrants are captured.

- Directionality (if any) of juveniles emerging from their pools of origin – This information is collected using the same trapping techniques as for adults, from June 15 to October 1. (Note: Between May 10 and June 15, either drift fences and traps should be removed, or trap-checking should continue daily.)

- Mapping habitat types – All known or suspected Jefferson and blue-spotted salamander habitats should be mapped from on-the-ground surveys and aerial photos (1:12,000 minimum scale, color-infrared, leaves-off photos, to increase the likelihood of detecting all vernal pools). Habitat types should be divided into the following general categories: seasonal pools, forested swamps (coniferous dominant, deciduous dominant, and mixed), other wetlands (forested swamps, shrub swamps, marshes, bogs, wet meadows, open

[1] Note: Currently, technical keys to facilitate reliable distinction between Jefferson/blue-spotted salamander eggs and spotted salamander eggs do not exist. Until such keys are developed, distinguishing egg masses requires considerable prior experience.

water), and forested uplands (coniferous dominant, deciduous dominant, and mixed). Maps should also include roads, high and low density development, and agricultural land. The resulting maps will be used by the Division to assess connectivity among breeding populations.

The Division issues permits for handling and capturing state-listed species in the field and therefore must be contacted before such activities are attempted.

GUIDELINES TO AVOID ADVERSE IMPACTS

Activities that may have adverse effects on Jefferson and blue-spotted salamander habitat and/or may kill or injure adults, juveniles, larvae, or eggs include but are not limited to the following.

- Destroying breeding pools or any portion of them by filling or draining.

- Degrading breeding pools. Examples of degradation include increasing erosion and sedimentation, clearing trees in and around pools, and discharging runoff and contaminants into pools.

- Altering the hydrology of breeding pools (see Skelly et al. 1999). Adding impermeable surfaces nearby, such as pavement and buildings, may increase runoff into the pools while water detention systems can decrease the amount of water that normally reaches a pool. Changing the elevation or grade of land adjacent to pools may also alter the amount of runoff.

- Introducing non-native species to pools. For example, if a pool's hydroperiod increases so that fish can survive in the pool, and fish are introduced, the survival of salamander eggs and larvae may be greatly reduced.

- Destroying or degrading upland habitats. Clear-cutting destroys upland habitat for Ambystomatid salamanders (see Deegan and Berkholtz 1989, Raymond and Hardy 1991, deMaynadier and Hunter 1995, deMaynadier and Hunter 1999) as does the removal of substrates for both salamanders and their prey, such as logs, rocks, and leaf litter. Clear-cutting and substrate removal alter the microclimate on the forest floor. Because Jefferson and blue-spotted salamanders may depend on small mammals for their burrows (Williams 1973), destruction and degradation of small mammal habitat may adversely impact Jefferson and blue-spotted salamanders.

- Adding sources of direct mortality in upland or breeding habitats. Examples include the removal or disturbance of burrowing substrates, the addition or increase of vehicular traffic, and the introduction or increase of environmental contaminants, such as pesticides, fertilizers, contaminants from malfunctioning septic systems, and runoff from roadways (see Lefcort et al. 1997, Diana and Beasley 1998).

- Impeding connectivity between upland, breeding, or dispersal habitats (see Reh and Seitz 1990, Gulve 1994, Dodd and Cade 1998, Gibbs 1998, deMaynadier and Hunter 1999). Roads, walls, curbs, clear-cuts, catch basins, and waterways are examples of impediments to salamander movement.

Because Jefferson and blue-spotted salamanders travel between habitat features that are hundreds of meters apart (Table 2), the activities listed above have the potential to adversely affect habitat or cause "take" of salamanders if they occur up to 625 m from documented salamander sightings. However, not all development activities within the range of maximum movement are likely to adversely affect actual habitat areas or to cause a taking. Each proposed project will be reviewed separately by the Division, and consideration will be given to site-specific conditions, the nature and extent of the proposed activity, the extent and quality of local salamander habitat, and knowledge of both the general ecology and local status of Jefferson/blue-spotted salamanders.

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